DOCUMENT RESUME

ED 136 871 JC 770 210

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TITLE Using Student Data for Community College Decision-Making; Three Examples Using Nonparametric Statistics. Brief No. 32.
INSTITUTION Virginia Western Community Coll., Roanoke. Office of Institutional Research.
PUB DATE 16 Jul 76
NOTE 8p.

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Community Colleges; *Decision Making; Educational Researchers; *Institutional Research; *Junior Colleges; *Nonparametric Statistics; *Statistical Analysis; Statistical Studies
IDENTIFIERS Chi Square Analysis; Kruskal Wallis Test; McNemar Test for Significance Change

ABSTRACT

This paper presents three examples of nonparametric statistical tests that can aid certain decision-making processes in the community college by using basic student data to separate "scientific" decision-making from "opinion" decision-making. A brief example of each test in a decision-making situation is related to illustrate the utility of the test. The McNemar Test for Significance Change is presented in order to examine certain enrollment changes. The Kruskal-Wallis Test examines the population distribution of several independent samples of mathematics placement scores as they relate to the high schools that the students attended. A Chi-Square Analysis is used to test the independence of students' curriculum choices and high schools attended. These tests are recommended to the beginning community college researcher because they are easily computed and explained, do not require samples drawn from a normally distributed population, and are easily understood both in terms of theory and application and thus are less likely to be used inappropriately than parametric statistical tests. A brief list of elementary statistical texts is included with the suggestion that the researcher review them when utilizing nonparametric statistics in the generation of decision-making information. (Author/JDS)

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Institutional Research Office

Virginia Western Community College

Brief No. 32

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Date July 16, 1976

ED136871

USING STUDENT DATA FOR COMMUNITY COLLEGE DECISION-MAKING

THREE EXAMPLES USING NONPARAMETRIC STATISTICS

ABSTRACT - Several nonparametric statistical tests are available that can effectively and efficiently measure the amount of subjectivity that goes into certain decision-making at the community college. These tests and procedures can effectively use basic student data to separate "scientific" decision-making from "opinion" decision-making. Three advantages of the tests and procedures are cited as follows:

1. The tests are easily computed and explained to statistical neophytes.
2. The tests are "distribution free" and do not require that the samples be drawn from normally distributed populations.
3. Because the theory behind the tests require no mathematics beyond high school algebra, the beginning researcher can more easily understand both the theory and its applications while being less apt to use the methods inappropriately.

The three examples investigated are cited as follows:

1. McNemar Test for Significance Change is used to examine the research question that students change their enrollment status thus providing additional facts that "explain" the low percentage of graduates as compared to total enrollments.
2. The Kruskal-Wallis Test is used to examine the research question that students from high schools W and X are mathematically more able than students from high schools Y and Z.
3. Chi-Square Analysis is used to test for the independence of students' curriculum choices and high schools that they attended.

The study concludes that certain nonparameter statistical tests may be more appropriate than the well-known parameter statistical tests such as the "T test", the "F test", and others. References for the nonparametric tests are cited.

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INTRODUCTION

Several nonparametric statistical tests are available that can measure the amount of subjectivity that goes into community college decision-making. These tests and procedures can separate "scientific" decision-making from "opinion" decision-making.

THREE EXAMPLES

This article presents three nonparametric statistical tests that may be appropriate for your decision-making processes. The tests are easily computed and explained to statistical neophytes. Since they are "distribution-free", no assumptions are made that the samples are drawn from normally distributed populations which is typically necessary in using many parametric statistics such as the "t-test", the "F-test", and others. A third advantage is that the theory behind these tests requires no mathematics beyond high school algebra. This fact is important in that a researcher who understands the theorical basis of a test is less apt to use that method inappropriately (Conover, 1971, p.3).

Test 1. The McNemar Test for Significance Change

A survey of students first enrolled in the Fall 1972 indicated that only 25% of these students graduated in the Spring 1974. Major concern has been expressed that the college is not presently providing revelant educational experiences as reflected by the low percentages of graduates. One opinion that appears plausible is that many students are enrolled part-time and will not have sufficient time to complete the total number of credits needed to graduate in two years. Another plausible opinion is that

many students change thier enrollment status from full-time to part-time implying that these students will be unable to graduate in Spring 1974. Therefore, the following null hypothesis H_0 is tested against the alternative hypothesis H_1:

H_0: The sample's enrollment status was not altered from Fall 1972.

H_1: There has been a change in the enrollment status of students from Fall 1972 to Fall 1973.

A random sample of 100 students enrolled both Fall 1972 and Fall 1973 indicated that in the Fall 1972 there were 55 full-time students and 45 part-time students. After one year the enrollment status of the same 100 students was examined. Of the 55 students who were enrolled full-time, it was noted that 16 of them were presently enrolled part-time. Of the 45 students enrolled part-time, it was noted that 5 of them were enrolled full-time for Fall 1973. The results are summarized in the following 2 x 2 contingency table:

Enrollment Status for Fall 1972	Enrollment Status for Fall 1973: Full-time	Enrollment Status for Fall 1973: Part-time	Total for Fall 1972
	39 a	16 b	55
	5 c	40 d	45
			100

The test statistic for the McNemar Test was computed as follows:

$$T = \frac{(b-c)^2}{b+c} = \frac{(16-5)^2}{16+5} = \frac{11^2}{21} = \frac{121}{21} = 5.762$$

The critical region of size alpha = .05 corresponds to all values of T greater than 3.841 from the Chi-Square Distribution. Because 5.762 exceeds 3.841, the null hypothesis (H_0) is rejected and the conclusion that students change their enrollment status is supported.

Further analysis of the table indicated the following:

1. Forty-five (45) students enrolled part-time in Fall 1972 have not had sufficient time to complete the total number of hours needed to graduate in two years. Further follow-up of the students is needed.

2. Sixteen (16) full-time students that changed to part-time enrollment have not had sufficient time to graduate in two years.

3. Five (5) students that enrolled part-time in Fall 1972 but changed to full-time in Fall 1973 have not had sufficient time to graduate in two years.

In summary, only 39% of the students (39) can be expected to graduate in the two year period. This number (39) should be compared to the actual number of graduates with recommendations for further follow-up studies.

Test 2. The Kruskal-Wallis Test

The Mathematics Department Chairman contends that students from high schools W and X are mathematically more able than students from high schools Y and Z. Is it possible that the guidance counselors from these high schools have stero-typed the community college and are recommending only certain types of students to enroll in the mathematics courses of the communuty college? Concern is expressed because the mathematics program of the college offers both developmental courses for low ability students and transfer courses for high ability students. The Coordinator of Institutional Research offers to examine this research question.

In order to investigate this problem it is proposed that all student scores of the mathematics placement test be examined in terms of the high school they attended. The scores of 34 students from the four high schools are cited.

High School W		High School X		High School Y		High School Z	
Math Score	Rank	Math Score	Rank	Math Score	Rank	Math Score	Rank
100	34	83	11	91	23	78	2
98	33	91	23	90	19.5	82	9
91	23	94	28.5	81	6.5	81	6.5
93	27	89	17	83	11	77	1
95	30	89	17	84	13.5	79	3
94	28.5	96	31.5	83	11	81	6.5
96	31.5	91	23	88	15	80	4
		92	26	91	23	81	6.5
		90	19.5	89	17		
				84	13.5		
	207.0		196.5		153.0		38.5
R_i	7		9		10		8
n_i							
N=34							

A computing form of the test statistic is cited as follows:

$$T = \frac{12}{N(N+1)} \sum_{i=1}^{k} \frac{R_i^2}{N_i} - 3(N + 1) = 25.46$$

Since T (25.46) is greater than the .95 quantile of a chi-square random variable with K-1=3 degrees of freedom (7.815), the null hypothesis

H_0: Student's scores from the four high schools are equivalent

is rejected in favor of the alternative hypothesis.

H_1: Student's scores from the four high schools are not equivalent.

This nonparameter test is certainly preferred over the usual parameter F-test because of problems of what happens (to levels of significance and power) when the basic assumptions of the F-test are violated (Glass and Stanley, 1970, p. 368).

The next logical step would be to examine these differences using one of the multiple comparisons tests that has been adapted for rank sum data. Conover (1971, p. 263) cites several references for these tests.

Test 3. Chi-Square Analysis

The Dean of Students has noted that students from certain high schools tend to choose the college transfer programs while students from other high schools typically enroll in occupational-technical programs. He is also certain that most students from H.S. 4 need one or more developmental courses. In order to test for differences in the probability distribution of high school and curriculum, a 3 x 4 contingency table is presented for students and their curriculum choices for Fall 1974.

	High School				
Curriculum	H.S. 1	H.S. 2	H.S. 3	H.S. 4	Total
Transfer	35	42	32	15	124
Occupational-Technical	64	75	55	31	225
Developmental	19	16	11	14	60
Total	118	133	98	60	409

The following hypothesis is tested:

H_0: The student's curriculum and high school are independent.

H_1: The student's curriculum and high school are not independent.

The test statistic is the chi-square test for independence. The rejection region for H_0 corresponds to values of T greater than 12.59, the .95 quantile of a chi-square random variable with $(r-1)(c-1) = 6$ degrees of freedom. The computed test statistics was 5.68 which is less than 12.59. Therefore, the null hypothesis is not rejected and the Dean should re-examine his opinions in terms of the distribution of students and their curricula.

SUMMARY

This article presents three nonparametric tests that can aid certain decision-making processes in the modern community college. McNemar Test for Significance Change is presented in order to examine certain enrollment changes. The Kruskal-Wallis Test examines the population distribution of several independent samples of mathematics placement scores in terms of the high schools that the students attended. A chi-square analysis tests the independence of curriculum choices and high schools. In discerning these tests it is strongly recommended that the researcher review certain elementary statistical textbooks cited under References. The study concludes that there are several nonparametric tests that can effectively and efficiently aid decision-making in the comprehensive community college.

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